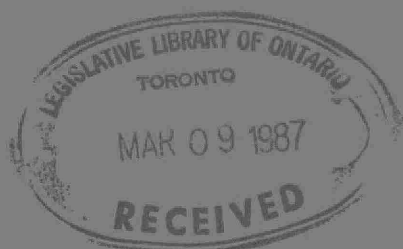


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SNOW SAMPLING SURVEY
in the vicinity of
GREAT LAKES FOREST PRODUCTS LIMITED
THUNDER BAY
February, 1985



Ontario

Ministry
of the
Environment

W.M. Vrooman
Regional Director
Northwestern Region

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SNOW SAMPLING SURVEY
in the vicinity of
GREAT LAKES FOREST PRODUCTS LIMITED,
THUNDER BAY
February, 1985

Report NW 86-04

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TECHNICAL SUPPORT SECTION
NORTHWESTERN REGION
ONTARIO MINISTRY OF THE ENVIRONMENT
January, 1987

INTRODUCTION

Snow sampling surveys were conducted in 1978 and 1982 near the Great Lakes Forest Products Limited complex in Thunder Bay.^{1,2} These studies revealed that calcium, sodium, sulphate and other particulate matter (wood or bark char, wood fines, and fly ash) were elevated in snow on and near company property. Levels of some of these substances declined in 1982, compared with 1978.

The 1982 survey was carried out before emission controls for particulate matter were installed in two of the mill's coal-fired boilers which had formerly operated without such controls. By November, 1983, particulate controls were in place on these boilers. To assess the effect of this abatement action, a snow sampling survey was conducted in February, 1985.

METHODS

Single samples of snow were collected on February 20-21, 1985 from 22 sites near the kraft mill (Figure 1) and from two control locations remote from the study area. All sampling sites corresponded to sites used in 1978 and 1982. Standard Ministry sampling procedures were followed in obtaining snow core samples.³ Snow meltwater samples were submitted to the Ministry's Thunder Bay laboratory for determination of calcium, sodium, chloride, sulphate, conductivity and pH. Analysis of carbon (total particulate carbon, dissolved organic carbon, dissolved inorganic carbon) and residues (total solids, dissolved solids, suspended solids) was performed at the Ministry's Toronto laboratory.

Contaminant guidelines for snow, developed by the Ministry of the Environment, are used in this report. Their exceedence would suggest that contamination may be present, but would not necessarily imply adverse effects.

RESULTS AND DISCUSSION

Trace to heavy quantities of wood fines and black particulate matter (wood or bark char) were noted on or below the snow surface at sites 2, 5, 18, 21, 24 and 34 on company property, and at sites 7, 8, 14, 15, 17, 20, 26, 27, 29, 31 and 32 off property.

Results of snow meltwater analysis are presented in Table 1, along with data from the 1978 and 1982 surveys. Contaminant guidelines for calcium, chloride, sodium, sulphate, conductivity and suspended solids were exceeded in all three surveys at many sampling sites on and off company property. Levels of calcium, chloride, sodium, sulphate, particulate residues, carbon, conductivity and pH were highest near the mill and decreased as distance from the mill increased. There was no clear trend of increasing or decreasing contaminant levels from 1978 to 1985. In 1985, calcium, chloride, sulphate, conductivity and pH were distributed in a pattern generally similar to that shown in Figure 2 for sodium. Total residues (Figure 3) and carbon were distributed in a bi-modal pattern. Figure 3 implicates the waferboard plant and an area near the north end of the kraft mill as sources of carbon-containing particulate matter.

Correlation matrices for snow meltwater chemistry are presented in Table 2a, 2b and 2c. In 1985, a strong, positive, linear relationship existed between calcium, chloride, sodium, sulphate, residues and conductivity (Table 2c). These relationships suggest that these contaminants originated from a common source. The strong positive correlation between carbon and residues and the strong negative relationship between these contaminants and distance from the waferboard plant and the wood chip storage area implicates these locations as sources of wood fines, as suggested in Figure 3. Similar but weaker correlations were found in the previous two surveys (Table 2a, 2b).

DISCUSSION AND CONCLUSIONS

The 1985 snow survey near Great Lakes Forest Products revealed elevated concentrations of calcium, chloride, sodium, sulphate, conductivity and suspended residues, both on and off company property. Guidelines for these contaminants were often exceeded. There was no obvious trend for an increase or decrease in the parameters tested from 1978 to 1985.

Visual observations, chemical analysis and correlation calculations indicated that the waferboard plant and the area near the wood chip piles were significant sources of wood fines. Black particulate matter, attributed to wood and bark char from the mill's power boilers, was observed in snow near these boilers and to the east off company property.

The effectiveness of the new emission controls on the power boilers could not be adequately assessed because of the interfering effects of air emissions from the waferboard plant and the wood chip piles. The waferboard plant closed at the end of May, 1986, thereby eliminating this source of particulate matter. A snow sampling survey is scheduled for the winter of 1986-87 to assess the current situation concerning particulate matter fallout. Dustfall monitoring will also continue near company property.

REFERENCES

1. Griffin, H. D. and D. J. Racette. 1978. Snow sampling survey, Great Lakes Paper Limited, Thunder Bay. February, 1978. Ontario Ministry of the Environment.
2. Racette, D. J. and H. D. Griffin. 1982. Snow sampling survey in the vicinity of Great Lakes Forest Products Limited, Thunder Bay. February, 1982. Ontario Ministry of the Environment.
3. Ontario Ministry of the Environment. 1982. Field investigation procedures manual. Phytotoxicology Section, Air Resources Branch.

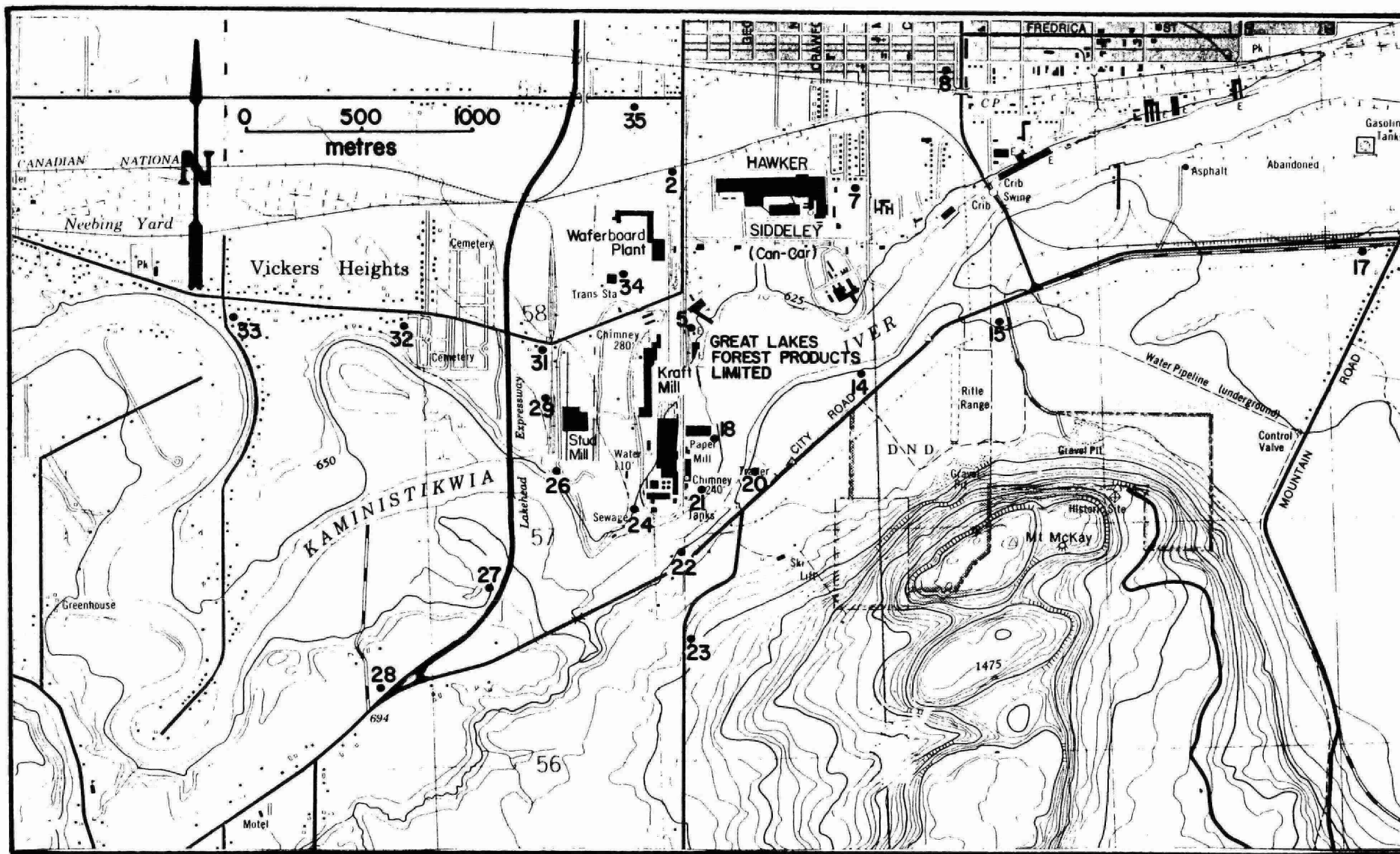


Figure 1. Snow sampling sites, Thunder Bay, February, 1985.

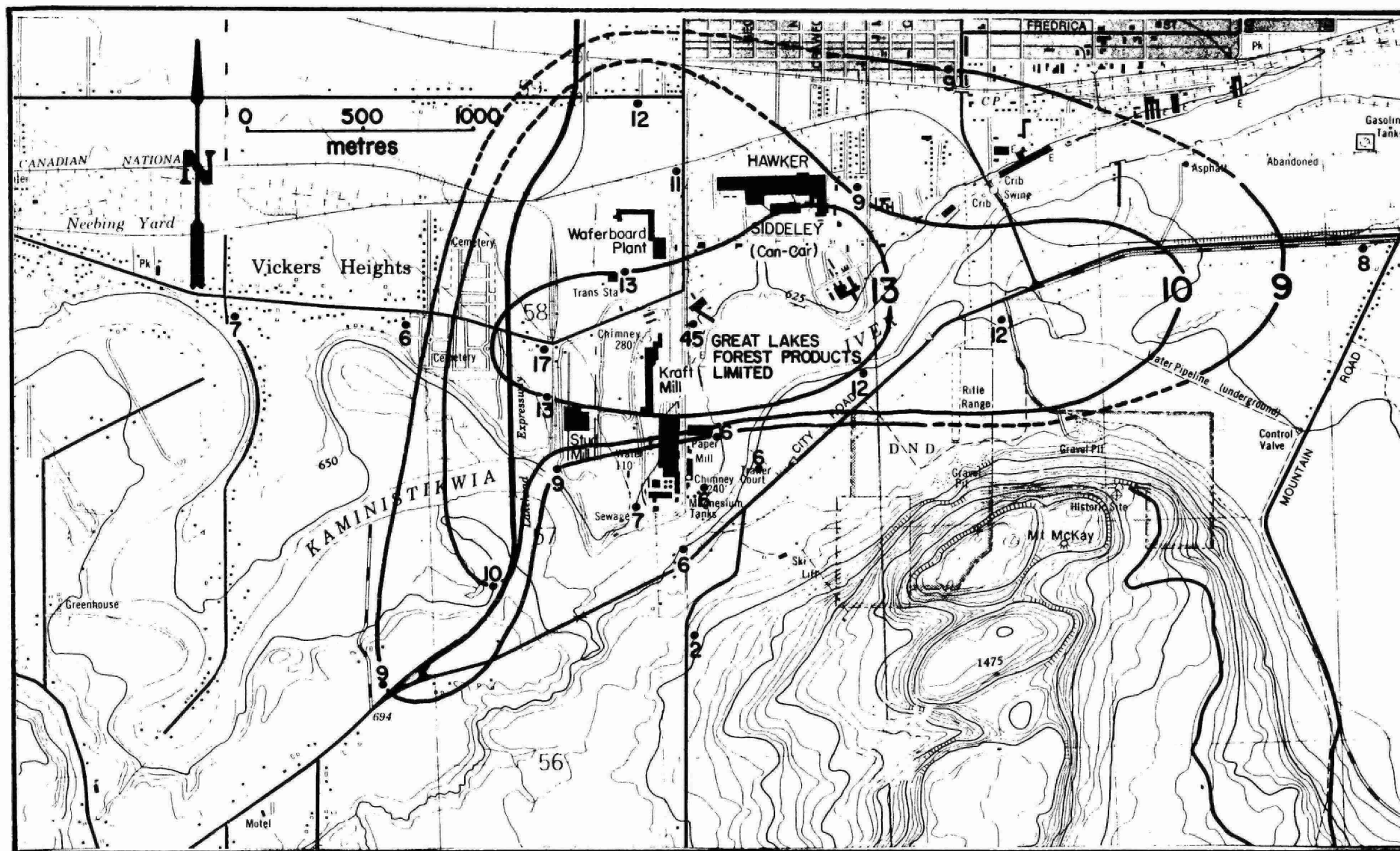


Figure 2. Levels of sodium (mg/l) in snow, Thunder Bay, February, 1985.



Figure 3. Total residues (mg/l) in snow, Thunder Bay, February, 1985.

TABLE 2(a). Correlation matrix of selected parameters in meltwater from snow collected near Great Lakes Forest Products Limited, Thunder Bay, February 13-14, 1978.

	Ca	Cl	Na	SO ₄	RSP	COND	pH
Cl	.37						
Na	.61*	.24					
SO ₄ ^a	.69*	.08	.92*				
RSP ^a	.09	.09	.20	.08			
COND	.66*	-.02	.89*	.95*	.29		
pH	.67*	.33	.18	.34	-.41	.23	
DISTPB ^b	.01	.11	-.39	-.42	-.03	-.32	.10
DISTWB ^c	.23	-.14	-.09	.04	-.41	.03	.59*
DISTCP ^d	.24	.03	-.27	-.20	-.19	-.14	.47*

* Denotes a significant correlation for pairs of elements at a 95% confidence level.

^a RSP = suspended solids.

^b Distance from sampling sites to the power boilers.

^c Distance from sampling sites to the waferboard plant.

^d Distance from sampling sites to the wood chip piles (Figure 3).

TABLE 2(b). Correlation matrix of selected parameters in meltwater from snow collected near Great Lakes Forest Forest Products Limited, Thunder Bay, February 16, 1982.

	Ca	Cl	Na	SO ₄	DIC	DOC	PTC	RSP	COND	pH
Cl	.09									
Na	.67*	.78*								
SO ₄ ^a	.92*	.17	.70*							
DIC ^b	.89*	.12	.59*	.85*						
DOC ^c	.98*	.10	.69*	.92*	.85*					
PTC ^d	.47*	.01	.21	.50*	.68*	.41*				
RSP ^e	.74*	.15	.52*	.84*	.80*	.72*	.80*			
COND	.94*	.42*	.87*	.90*	.86*	.93*	.41*	.72*		
pH	.62*	.05	.34	.60*	.87*	.52*	.69*	.67*	.60*	
DISTPB ^f	-.17	-.01	-.10	-.33	-.22	-.20	-.31	-.44*	-.17	-.16
DISTWB ^g	-.28	-.42*	-.46*	-.37	-.35	-.34	-.25	-.40*	-.41	-.21
DISTCP ^g	-.27	-.30	-.39*	-.45*	-.32	-.33	-.26	-.46*	-.37	-.18

* Denotes a significant correlation for pairs of elements at a 95% confidence level.

^a DIC = dissolved inorganic carbon.

^b DOC = dissolved organic carbon.

^c PTC = particulate total carbon.

^d RSP = suspended solids.

^e Distance from sampling sites to the power boilers.

^f Distance from sampling sites to the waferboard plant.

^g Distance from sampling sites to the wood chip piles (Figure 3).

TABLE 2(c). Correlation matrix of selected parameters in meltwater from snow collected near Great Lakes Forest Products Limited, Thunder Bay, February 20-21, 1985.

	Ca	Cl	Na	SO ₄	DIC	DOC	PTC	RSF	RSP	RST	COND	pH
Cl	.53*											
Na ₄	.81*	.73*										
SO	.89*	.58*	.96*									
DIC ^a	.60*	.56*	.52*	.50*								
DOC ^b	.68*	.61*	.80*	.77*	.77*							
PTC ^c	.28	.35	.38	.35	.69*	.81*						
RSF ^d	.89*	.68*	.96*	.96*	.66*	.89*	.52*					
RSP ^e	.38	.42*	.49*	.46*	.71*	.87*	.99*	.62*				
RST ^f	.52*	.50*	.63*	.61*	.75*	.94*	.95*	.75*	.98*			
COND	.92*	.68*	.97*	.99*	.57*	.80*	.36	.98*	.48*	.62*		
pH	.76*	.28	.39	.50*	.37	.17	-.14	.45*	-.07	.04	.54*	
DISTRB ^g	-.32	-.11	-.05	-.12	-.40*	-.22	-.23	-.21	-.23	-.24	-.16	-.19
DISTWB ^h	-.32	-.43*	-.39	-.34	-.59*	-.58*	-.59*	-.45*	-.61*	-.61*	-.38	.04
DISTCP ⁱ	-.37	-.39	-.29	-.28	-.58*	-.48*	-.46*	-.40*	-.47*	-.48*	-.33	-.10

* Denotes a significant correlation for pairs of elements at the 95% confidence level.

^a DIC = dissolved inorganic carbon

^b DOC = dissolved organic carbon

^c PTC = particulate total carbon

^d RSF = dissolved solids

^e RSP = suspended solids

^f RST = total solids

^g Distance from sampling sites to the power boilers.

^h Distance from sampling sites to the waferboard plant.

ⁱ Distance from sampling sites to wood chip piles (Figure 3).

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